Advanced Estimates of Regional Accounts: An Alternative Approach by Spatial Panels

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Abstract

The policies related to regional economic activity developed by European Union (EU) and the role played by regions as economic subject have determined a bigger set of disaggregated statistics at macroeconomic level. The methodologies used nowadays by the Italian national institute of statistics (ISTAT) are based on an information set build on the basis of inner statistical surveys and other external sources. The estimates of regional accounts carried out on the complete information set require an amount of time bigger than the one expected for the already mentioned aims. A strong need to carry out advanced estimates of regional accounts in a quicker time has emerged. The Kalman filter could be the right tool if we use a short time series span. Since it is available a larger data set from ISTAT web site (www.istat.it) from 1980 up to 2004, a different approach will be performed here, and is mainly based on Spatial Panel recently used by Elhorst and Baltagi. SAR (simultaneous autocorrelation model) and SEM (simultaneous error model) will be used. In a similar fashion the first log differences of ULA (units of labour) will be used to forecast the first log differences of four value added branches at constant prices. Finally some conclusions will be drawn on the performances of SAR and SEM.

Keywords:Panel data models, spatial autocorrelation

JEL classification:C21,C22,C23

1. Introduction

Advanced estimates of regional accounts (since now AERA) have been produced by ISTAT since 2002. These results are strictly connected with regional policies and structural funds. The Italian Ministry of Treasury wanted AERA to shrink the release of the most important economic regional data. This paper will focus on an alternative approach to estimate Value Added at constant basic 1995 prices of Italian regions. A model about this subject was developed in 2000 (see Proietti (2002)). Proietti uses Kalman filter

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technology (see Harvey (1989)) and by particular initialization formula (see Koopman (1997)) obtains the estimates needed. If on one hand no further effort is necessary on this path, on the the other hand many approaches have already been developed to study panel data models with dependent units. In the field of regional convergence, for instance, panel data overcome problems due to omitted regional-specific, time-invariant variables and the imposition of complete regional homogeneity (see Arbia and Piras (2004)). The spatial econometric literature spins on the work of Luc Anselin (see Anselin and Bera (1998), Anselin and Bera (1998)). Elhorst (2001) described how perform estimation of panel data model with spatial effects. Another good source for this type of estimation is given by Baltagi (see Baltagi and Li (2004)) and Elhorst (see Elhorst (2003)). For the first time in this paper regional Value Added at constant 1995 basic prices will be forecasted using information given by full -time equivalent (hereafter ULA or units of labour) and by a spatial contiguity matrix. As consequence in this paper many of the features already analyzed by Proietti will be used, but taking into account spatial dependence among Italian regions. The main innovation will be in considering spatial effects in addition to the serial effects in panel data models. The outline of the paper will be the following. A short review of the econometric models used by Proietti will be given in the succeeding section. These models are build under the assumption that there is a negligible spatial autocorrelation patter in short time series span. As a consequence of this, the spatial correlation pattern on first log differences of productivity of labour on four value added branches at basic 1995 prices with respect to national productivity average will be inspected.
The test used here will be the following: Moran's test, Lagrange multiplier's test proposed by Burridge, and finally the Geary 's index. A brief overview of related models that could be strictly linked with AERA will be given in the fourth section. In the fifth section the already mentioned spatial models will be estimated and their performance will be evaluated.

2. The building block with first log differences

The regional value added at constant prices is estimated by two models (see Proietti (2002)). The first is simpler than the second. It is based on extrapolation of labor's productivity using the following equation:

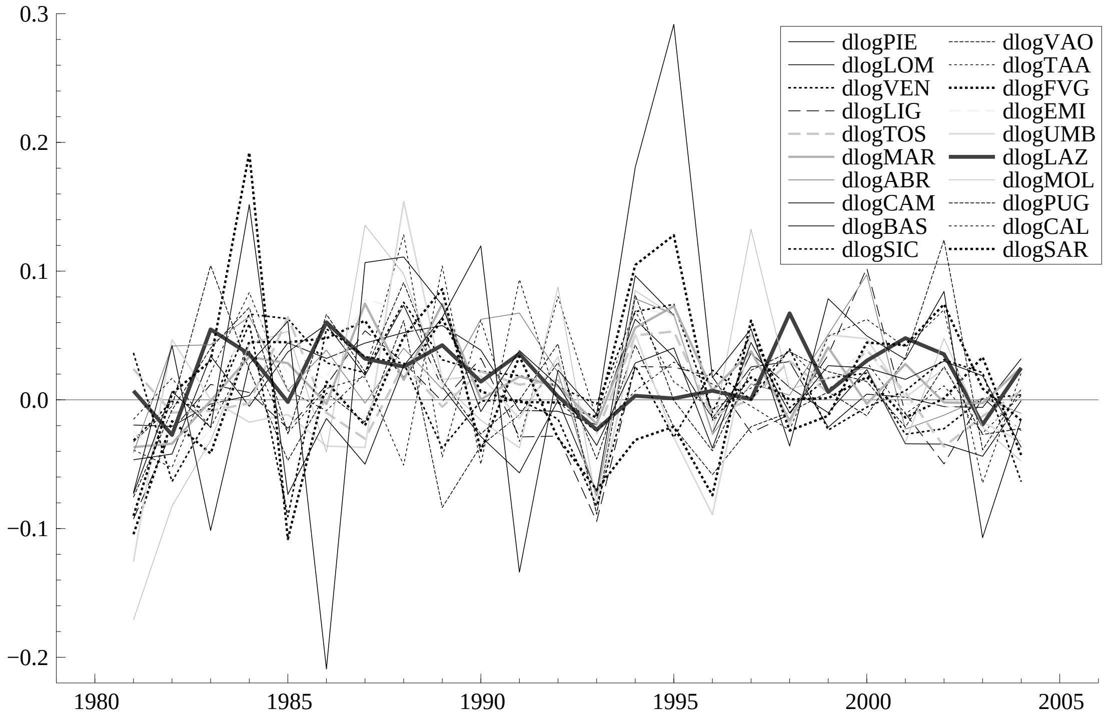
$$\Delta \ln p_t = \Delta \ln y_t - \Delta \ln l_t = \mu + \beta_f f_{1t} + \epsilon_t, \quad \epsilon_t \sim NID(0, \Sigma\epsilon_t)$$

The drift μ_i is invariant with respect to regions. The first factor stands for the dynamic of regional labor's productivity. The variance matrix $\Sigma\epsilon_t$ is also expressed by a factorial model, where the are two components. The first one is common to all regions and the second one γ stands for regional etheroskedasticity. Eventually the ratio between σ_N^2/σ_*^2 gives a weight for national component. The second model is a dynamic panel. It uses as co-variates units of labour (since now ULA) and the first factor about regional productivity's growth that has already been mentioned.

$$\Delta \ln y_t = \phi \Delta \ln y_{t-1} - \mu + \beta_0 \Delta \ln l_t + \beta_1 \Delta \ln l_{t-1} + \beta_f f_{1t} + \epsilon_t, \quad \epsilon_t \sim NID(0, \Sigma_\epsilon)$$

It is straightforward to notice how the second encompasses the first, when $\phi = 0, \beta_0 = 1, \beta_1 = 0$. It is important to point out that the latter model differs from the former also for the estimation method. For the second equation the Kalman filter's technology with national time series from 1970 up to 2004 is used.

Figure 1: First Log Differences of Industry Including Energy from 1982 up to 2003 at 1995 basic prices



3. The Data

The data I use are freely downloadable from ISTAT web site [1]. It is interesting to note how some regions have a similar flow. In figures 1-8 all the data used in the next section are showed.

31 Spatial Autocorrelation

In this section spatial autocorrelation concerning first log differences of productivity of labour will be explored. This type of analysis largely draws from Anselin's work Anselin and Bera (1998) and from Proietti (2002). For sake of simplicity our building block will be a contiguity matrix, that expresses the link among Italian regions.
In other words, this matrix W , is obtained by the connection matrix C, where its elements are $c_{ij} = 1$ if the regions *i* and *j* share a common border and $c_{ij} = 0$ otherwise, standardizing the rows by dividing for the number of connections. Thus the elements in each cell will sum up to unity. The first spatial autocorrelation test operates on the residuals by regressing the first log difference of productivity of labour on a costant. This is done to check wether there is spatial dependence with respect to national average.
This is the Moran test

$$I = \frac{e'We}{e'e},$$

[1]The URL is "http://www.istat.it/dati/dataset/" at the link Conti Regionali

Figure 2: First Log Differences of units of labours of Industry Including Energy from 1982 up to 2003

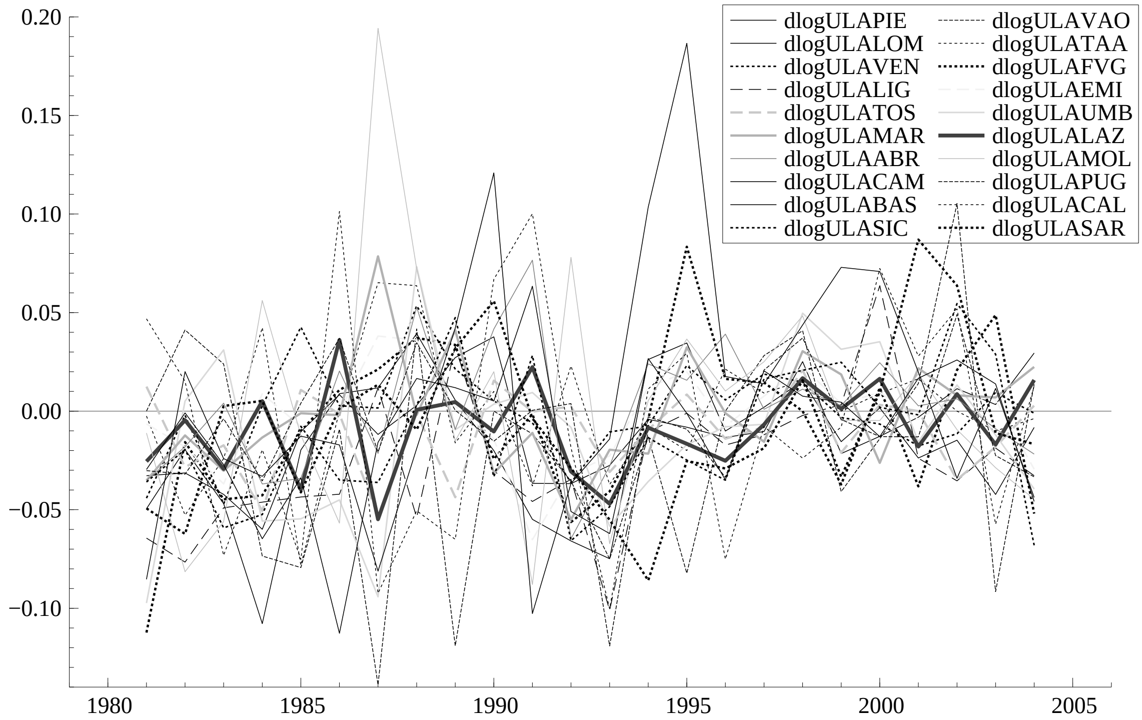


Figure 3: First Log Differences of Wholesale and Retail Trade, Repair of Motor Vehicles and Household Goods, Hotels and Restaurants, Transports and Communications from 1982 up to 2003 at 1995 basic prices

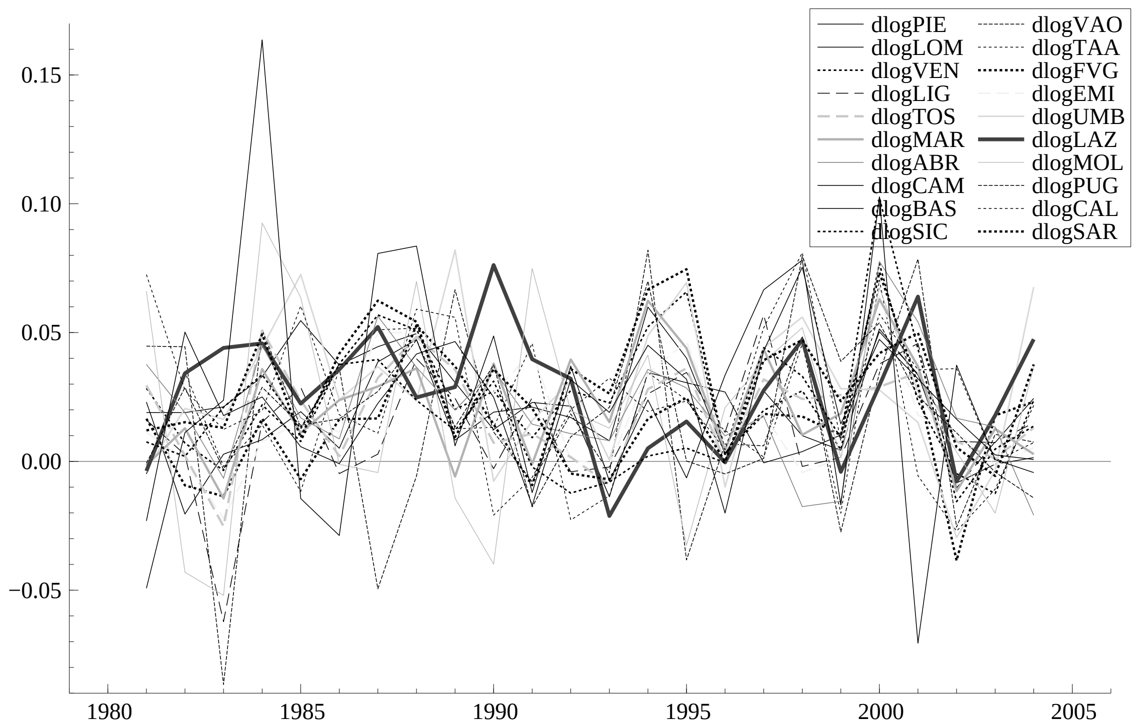


Figure 4: First Log Differences of units of labours of Wholesale and Retail Trade, Repair of Motor Vehicles and Household Goods, Hotels and Restaurants, Transports and Communications from 1982 up to 2003

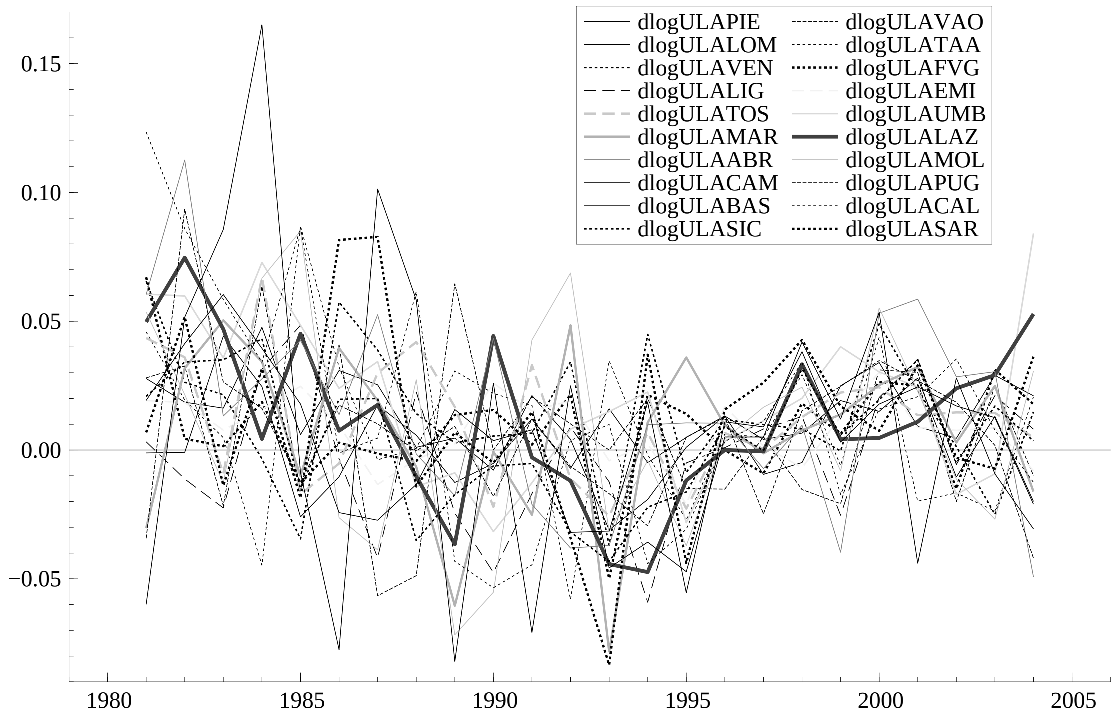


Figure 5: First Log Differences of Intermediation for Financial, Real Estate, Renting and Business Activities from 1982 up to 2003 at 1995 basic prices

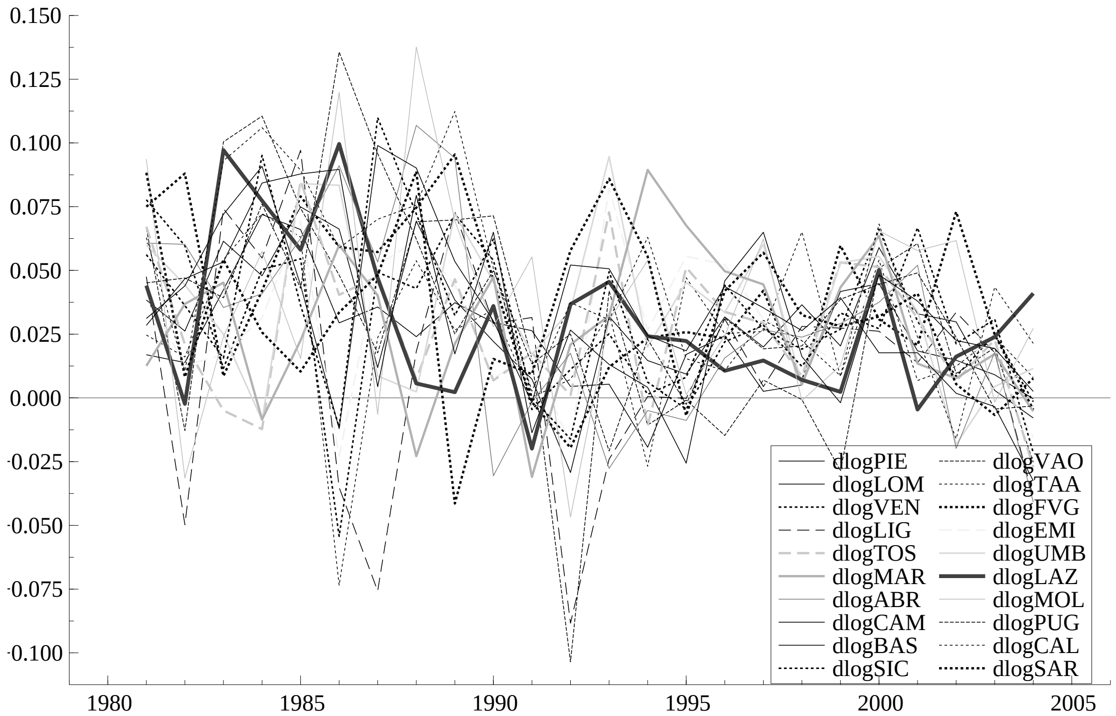


Figure 6: First Log Differences of units of labours of Intermediation for Financial, Real Estate, Renting and Business Activities from 1982 up to 2003 at 1995 basic prices

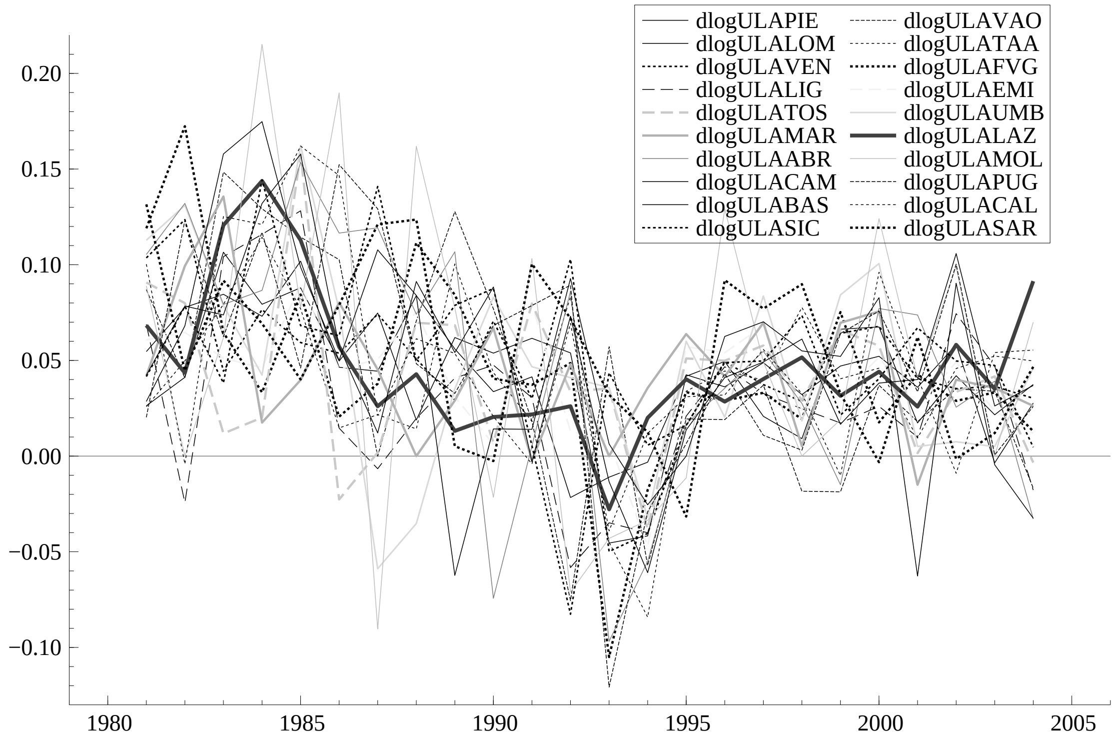


Figure 7: First Log Differences of Other services and activities from 1982 up to 2003 at 1995 basic prices

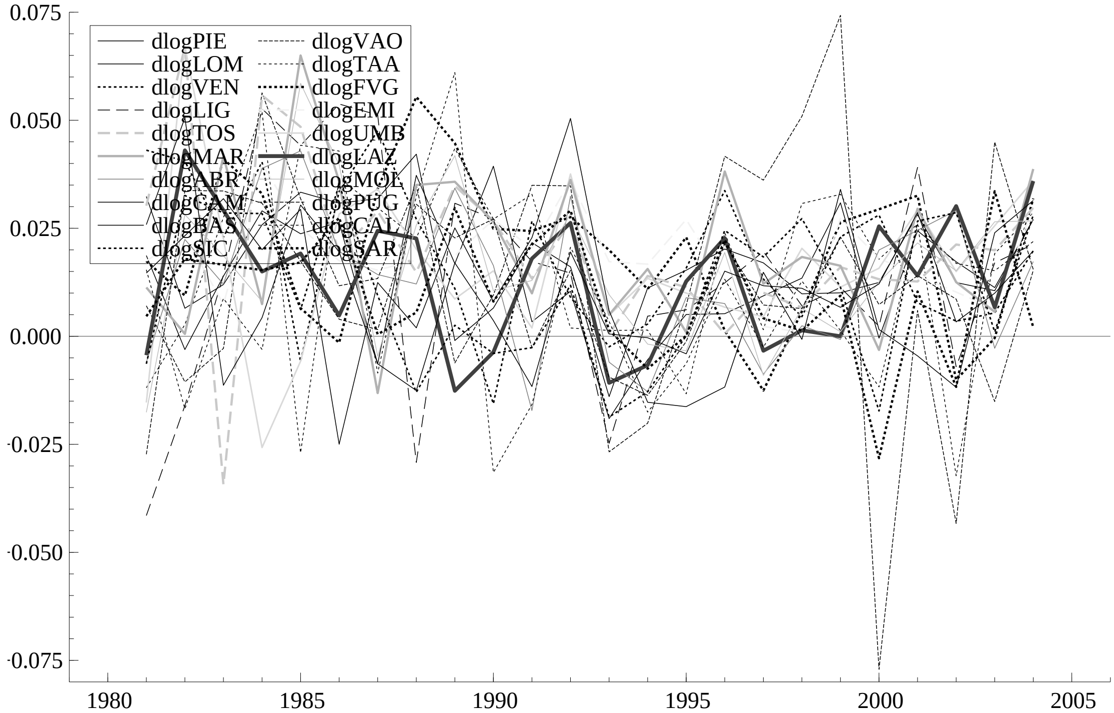
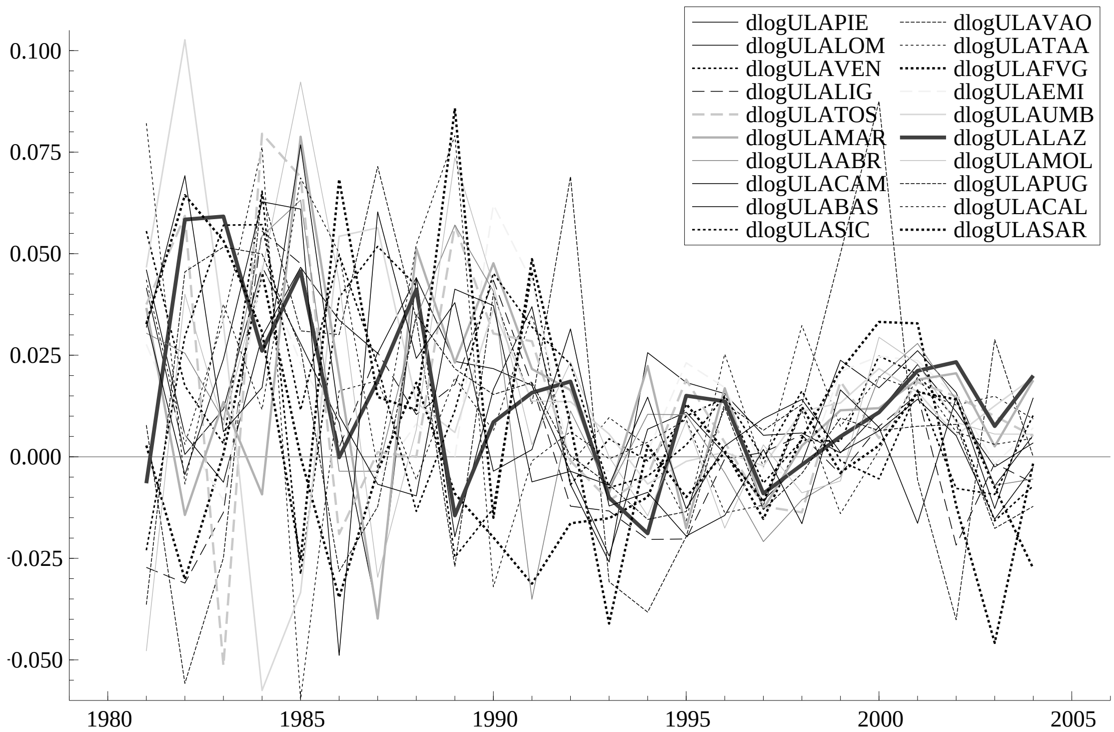


Figure 8: First Log Differences of units of labours of Other services and activities



that is LBI (*Locally Best Invariant*) under the hypothesis $H_0 : \rho = 0$ against $H_1 : \rho \neq 0$ when e has a spatial autoregressive process $\epsilon = \rho W \epsilon + \xi$, where $\xi \sim N(0, \sigma^2_\xi I)$. The critical values of this test are obtained by a MonteCarlo simulation using a representation of a distribution as a weighted average of χ^2 random variable with one degree of freedom (see expression (48) in Anselin and Bera (1998)). An asymptotic normal distributed test is the standardized I (here after I_S) , even though appears quite cumbersome to use such test with few units (twenty regions).
The second test is a Lagrange Multiplier test (here after LM) proposed by Burridge.
In LM, $H_0 : \rho = 0$ within the already mentioned spatial autoregressive model. Moreover it is possible to show that LM allows us to check wether there is no spatial dependence when e follows a spatial moving average $e = \xi + \rho W \xi$.
The critical values (since now B) are given by the quantile of a χ^2 with one degree of freedom, and are computed by this equation:

$$B = \left(\frac{e'We}{s^2} \right) \frac{1}{tr\left[\left(W' + W \right) W \right]'}$$

with $s^2 = \dfrac{e'e}{R}$, and tr() that stands for the trace of the matrix in round brackets.

Finally, the last test used id Geary's Index,

$$G = \frac{R-1}{2Rs^2} \left(\frac{\left(e \odot e \right)' W * i_R + i'_R W \left(e \odot e \right) - 2e' W * e}{R} \right)$$

Note how the second fraction stands for the average quadratic difference among regions weighted by the contiguity matrix. The expected value of the index in absence of spatial

dependence is equal to one, and values between zero and one are expression of positive spatial autocorrelation, while values above one stand for negative spatial autocorrelation. The results for the four value added branches at 1995 basic prices are given in tables 1-4. Al the tests consider the residuals of first log of differences of productivity regressed with respect to a constant.
For Industry Including Energy from 1982 up to 1985, the p-value of LM of Burridge decreases from 0.996 down to 0.078, meanwhile Geary Index increases from 1.012 up to 1.251. In the same way I_S increases in absolute value. In 1988 there are conflicting results, since the null hypothesis is accepted by LM, while Geary reveals negative spatial correlation.
As a matter of the fact Geary is close to one only in 1995 and 1997, while in the remaining years is significantly different from one. The I_S shows its highest value in 1987.

Table 1: Indexes of Spatial Autocorrelation for first log differences of productivity of labour from 1982 up to 2003 about Industry Including Energy

Year	Moran	Moran std.	Burridge	p-value	Geary
(1982)	-0.001	0.292	0.000	0.996	1.012
(1983)	-0.074	-0.167	0.143	0.706	1.017
(1984)	-0.136	-0.559	0.486	0.486	1.201
(1985)	-0.344	-1.868	3.100	0.078	1.251
(1986)	0.055	0.642	0.078	0.780	1.051
(1987)	0.281	2.069	2.074	0.150	0.799
(1988)	0.122	1.066	0.390	0.532	0.810
(1989)	-0.125	-0.486	0.407	0.524	1.031
(1990)	0.199	1.550	1.036	0.309	0.731
(1991)	0.002	0.309	0.000	0.993	0.942
(1992)	-0.204	-0.984	1.086	0.297	1.376
(1993)	-0.210	-1.023	1.153	0.283	1.302
(1994)	0.035	0.518	0.032	0.858	0.766
(1995)	-0.151	-0.651	0.596	0.440	1.010
(1996)	-0.203	-0.982	1.083	0.298	1.150
(1997)	-0.188	-0.883	0.921	0.337	1.055
(1998)	-0.127	-0.501	0.422	0.516	1.127
(1999)	-0.244	-1.235	1.553	0.213	1.183
(2000)	0.170	1.369	0.759	0.384	0.731
(2001)	-0.159	-0.700	0.659	0.417	0.933
(2002)	-0.121	-0.465	0.385	0.535	1.232
(2003)	-0.269	-1.396	1.896	0.168	1.301

For Wholesale and Retail Trade, Repair of Motor Vehicles and Household Goods, Hotels and Restaurants, Transports and Communications, the Geary's index is close to one only in 1989, 1991, 1996 and 2002, while in the other years reaches peaks of 1.313 in 1997, and slows down from 1.227 up to 0.521 in 1987.
The LM test is strongly rejected in the following two years: 1983, 1987. The I_S shows its highest value in 1987.

For Intermediation for Financial, Real Estate, Renting and Business Activities Geary's

Table 2: Indexes of Spatial Autocorrelation for first log differences of productivity of labour from 1982 up to 2003 about Wholesale and Retail Trade, Repair of Motor Vehicles and Household Goods, Hotels and Restaurants, Transports and Communications

Year	Moran	Moran std.	Burridge	p-value	Geary
(1982)	0.100	0.929	0.263	0.608	0.813
(1983)	-0.386	-2.132	3.902	0.048	1.280
(1984)	0.164	1.332	0.707	0.400	0.745
(1985)	0.081	0.810	0.173	0.677	0.980
(1986)	-0.148	-0.632	0.572	0.449	1.227
(1987)	0.449	3.126	5.288	0.021	0.521
(1988)	0.076	0.777	0.151	0.697	0.987
(1989)	-0.077	-0.183	0.153	0.695	1.036
(1990)	0.136	1.155	0.485	0.486	0.768
(1991)	0.079	0.794	0.162	0.687	1.015
(1992)	-0.066	-0.120	0.116	0.734	0.719
(1993)	0.018	0.411	0.008	0.927	0.766
(1994)	0.254	1.894	1.682	0.195	0.811
(1995)	0.085	0.834	0.190	0.663	0.759
(1996)	-0.081	-0.214	0.174	0.677	1.049
(1997)	-0.213	-1.039	1.182	0.277	1.313
(1998)	-0.157	-0.690	0.646	0.422	1.165
(1999)	-0.320	-1.713	2.674	0.102	1.296
(2000)	-0.050	-0.017	0.066	0.798	1.181
(2001)	0.192	1.507	0.966	0.326	0.872
(2002)	0.011	0.364	0.003	0.957	1.083
(2003)	0.242	1.818	1.527	0.217	0.634

index is close to one only in three years: 1997, 1999 and 2002. The LM test strongly rejects the null hypothesis in 1982, 1989, 1992,1995 ,1998 and 2000. It is interesting to note how I_S reaches its highest absolute values in the same years.

For Other Activities Geary is close to one in the following years: 1987,1993,1997. The LM test of Burridge is rejected in 1988,1990. In the same years I_S reaches its highest values in absolute values.

The main conclusion is drawn here is that is not possible to neglect the the presence of a spatial autocorrelation in these type of data.

4. Spatial Models

Elhorst observes (Elhorst (2001)) that: "To model spatial dependence between observations, the model may take the form of a spatial autoregressive process in the error term or in the variable to explain. The first is known as the *spatial error* and the second as the *spatial lag case*." In this section I will show how is possible to obtain four distinct spatial error models, and other four distinct spatial lag models.

Table 3: Indexes of Spatial Autocorrelation for first log differences of productivity of labour from 1982 up to 2003 about Intermediation for Financial, Real Estate, Renting and Business Activities

Year	Moran	Moran std.	Burridge	p-value	Geary
(1982)	0.326	2.349	2.781	0.095	0.641
(1983)	0.185	1.462	0.896	0.344	0.767
(1984)	0.316	2.285	2.610	0.106	0.758
(1985)	-0.243	-1.233	1.550	0.213	1.171
(1986)	-0.234	-1.176	1.437	0.231	1.166
(1987)	0.253	1.890	1.676	0.195	0.710
(1988)	0.148	1.232	0.576	0.448	0.769
(1989)	0.331	2.379	2.861	0.091	0.568
(1990)	-0.127	-0.502	0.424	0.515	0.855
(1991)	-0.231	-1.154	1.393	0.238	1.308
(1992)	-0.406	-2.255	4.307	0.038	1.204
(1993)	-0.004	0.274	0.000	0.985	0.894
(1994)	0.131	1.122	0.448	0.503	0.845
(1995)	0.368	2.615	3.547	0.060	0.738
(1996)	0.072	0.750	0.135	0.713	0.982
(1997)	-0.004	0.276	0.000	0.986	1.004
(1998)	0.390	2.754	3.986	0.046	0.570
(1999)	-0.244	-1.239	1.562	0.211	1.049
(2000)	0.440	3.067	5.069	0.024	0.539
(2001)	0.248	1.859	1.610	0.205	0.547
(2002)	-0.209	-1.015	1.140	0.286	1.077
(2003)	-0.321	-1.723	2.700	0.100	1.207

41 Panel Data Models Extended to Spatial Error or Lag

The spatial matrix W I mentioned before to compute spatial autocorrelation tests will be used even here. The observations are stacked as one equation for each cross-section at one point in time.

The fixed effects model extended to spatial error autocorrelation can be specified as

$$\Delta \ln y_t = \alpha_0 \Delta \ln y_{t-1} + \beta_0 \Delta \ln l_t + \beta_1 \Delta \ln l_{t-1} + \mu + \phi_t, \tag{1}$$

$$\phi_t = \delta W \phi_t + \epsilon_t$$
$$E(\epsilon_t) = 0$$

$$E(\epsilon_t \epsilon_t) = \sigma^2 I_N$$

and to a spatially lagged dependent variable as

$$\Delta \ln y_t = \delta W \Delta \ln y_t + \alpha_0 \Delta \ln y_{t-1} + \beta_0 \Delta \ln l_t + \beta_1 \Delta \ln l_{t-1} + \mu + \epsilon_t \tag{2}$$

$$E(\epsilon_t) = 0$$

Table 4: Indexes of Spatial Autocorrelation for first log differences of productivity of labour from 1982 up to 2003 about Other Activities of Services

Year	Moran	Moran std.	Burridge	p-value	Geary
(1982)	0.117	1.036	0.360	0.549	0.895
(1983)	0.005	0.330	0.001	0.979	0.784
(1984)	0.014	0.384	0.005	0.945	1.231
(1985)	-0.017	0.191	0.008	0.931	0.874
(1986)	-0.198	-0.947	1.025	0.311	1.166
(1987)	0.075	0.768	0.146	0.703	1.085
(1988)	0.412	2.888	4.435	0.035	0.407
(1989)	0.154	1.264	0.617	0.432	0.902
(1990)	-0.482	-2.734	6.076	0.014	1.235
(1991)	0.146	1.219	0.561	0.454	0.293
(1992)	0.251	1.877	1.647	0.199	0.872
(1993)	-0.209	-1.016	1.142	0.285	1.046
(1994)	0.011	0.370	0.003	0.953	0.966
(1995)	0.208	1.610	1.137	0.286	0.837
(1996)	-0.139	-0.575	0.503	0.478	0.986
(1997)	-0.060	-0.081	0.095	0.758	1.066
(1998)	0.184	1.453	0.882	0.348	0.765
(1999)	-0.246	-1.251	1.585	0.208	1.325
(2000)	-0.070	-0.145	0.130	0.719	0.886
(2001)	0.215	1.652	1.211	0.271	0.702
(2002)	-0.049	-0.013	0.064	0.801	1.196
(2003)	-0.039	0.050	0.041	0.840	0.937

$$E(\epsilon_t \epsilon_t) = \sigma^2 I_N$$

As in Baltagi (1995) and Elhorst (2001) the log-likelihood function corresponding to the demeaned equation extended to spatial error autocorrelation is

$$\frac{-NT}{2} ln\left(2\pi\sigma^2\right) + T\sum_{i=1}^{N} ln\left(1-\delta\omega_i\right) - \frac{1}{2\sigma^2}\sum_{t=1}^{T} e_t^{'} e_t \tag{3}$$

$$e_t = \left(I - \delta W\right)\left[Y_t - \overline{Y} - \left(X_t - \overline{X}\right)\eta\right]$$

where Y stands for the dependent variable, X for all regressors and the vector η for all coefficients to be estimated. For the spatial lagged dependent variable the log-likelihood function is the following

$$\frac{-NT}{2} ln\left(2\pi\sigma^2\right) + T\sum_{i=1}^{N} ln\left(1-\delta\omega_i\right) - \frac{1}{2\sigma^2}\sum_{t=1}^{T} e_t^{'} e_t \tag{4}$$

$$e_t = \left(I - \delta W\right)\left(Y_t - \overline{Y}\right) - \left(X_t - \overline{X}\right)\eta$$

where again Y stands for the dependent variable, X for all regressors and the vector η for all coefficients to be estimated.

Considering this last log-likelihood function is possible to estimate four simple models (here after SAR1, SAR2, SAR3, SAR4):

1. pooled model corrected for spatial autocorrelation, including intercept (i.e. the ordinary least squares plus spatial autocorrelation);
2. spatial fixed effect plus spatial autocorrelation (i.e. y and x are taken in deviation from their spatial means);
3. time period fixed effect plus spatial autocorrelation (i.e. y and x are taken in deviation from their time means);
4. spatial and time period fixed effect (i.e. y and x are taken in deviation both form their spatial and their time means);

In the same way is possible to obtain SEM1, SEM2, SEM3,and SEM4. For models staring form 2 up to four I won't include the intercept. In the next section I will show the main results.

5. Results

In order to evaluate the performance of the eight different models I use a rolling one-step forecast [2]. This one begins with four observations and ends when the twentythird is reached. In figures 9-16 I plot the value of the five coefficients estimated every time for every value added branch (Industry including Energy, Wholesale and Retail Trade, Repair of Motor Vehicles and Household Goods, Hotels and Restaurants, Transports and Communications, Intermediation for Financial, Real Estate, Renting and Business Activities, Other services and activities). For the first branch the most stable in terms of parameters' stability is SAR1 and SEM1. For the second branch SAR4 seems to give the best results, even though,the first and the third coefficient are yet unstable over time. For the third branch SAR2 and SEM2 show good results of overall stability from 1994 up to 2003. Finally for the fourth branch SAR1 and SEM1 performs reasonably well. If on one hand the constant is unstable over time , the reaming parameters are quite stable over time. SAR2 for Other services and activities is the best model in terms of stability.

6. Conclusions

The main goal of this paper was to show how is possible to produce forecast of four value added branches related to twenty Italian regions using spatial panel.The strategy followed here uses the usual tests (Moran test, LM of Burridge, Geary's Index) to check some spatial autocorrelation pattern in first log difference of value added at constant 1995 basic prices with respect to national average or first log difference of productivity with respect of a constant. The results shown on tables 1-4 reveal that spatial autocorrelation is not at all a negligible issue and as a matter of the fact should be taken into account using a longer time series span. Eight models were used. More exactly four (respectively SER1, SER2, SER3, SER4) taking into account a spatial error component together with the

[2] The Matlab routines used here are freely downloadble from "www.spatial-econometrics.com" and are explained in Elhorst (2003)

Figure 9: Plot of coefficients estimated using a rolling window from 1986 up to 2003 for SAR1

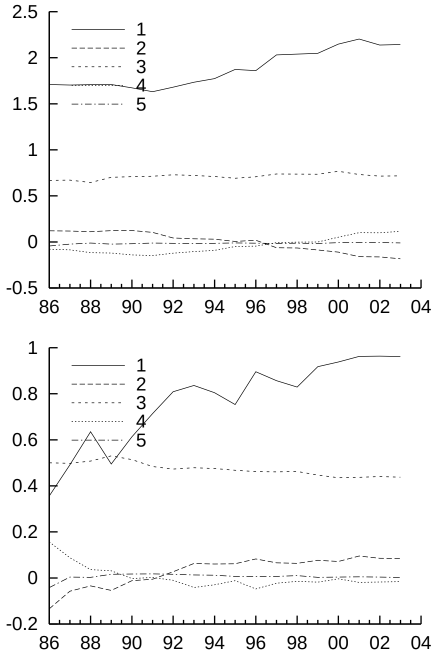


Figure 10: Plot of coefficients estimated using a rolling window from 1986 up to 2003 for SEM1

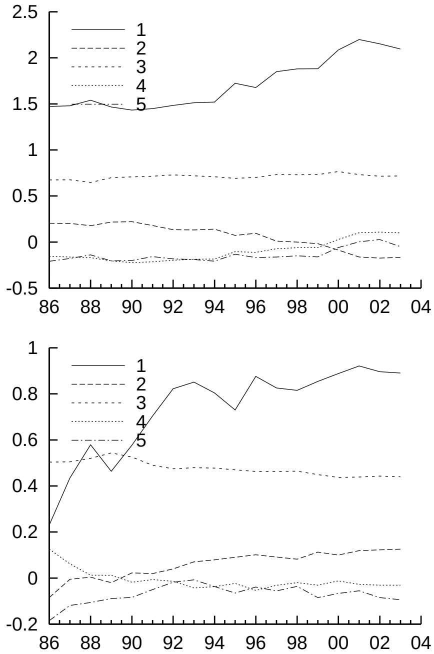


Figure 11: Plot of coefficients estimated using a rolling window from 1986 up to 2003 for SAR2

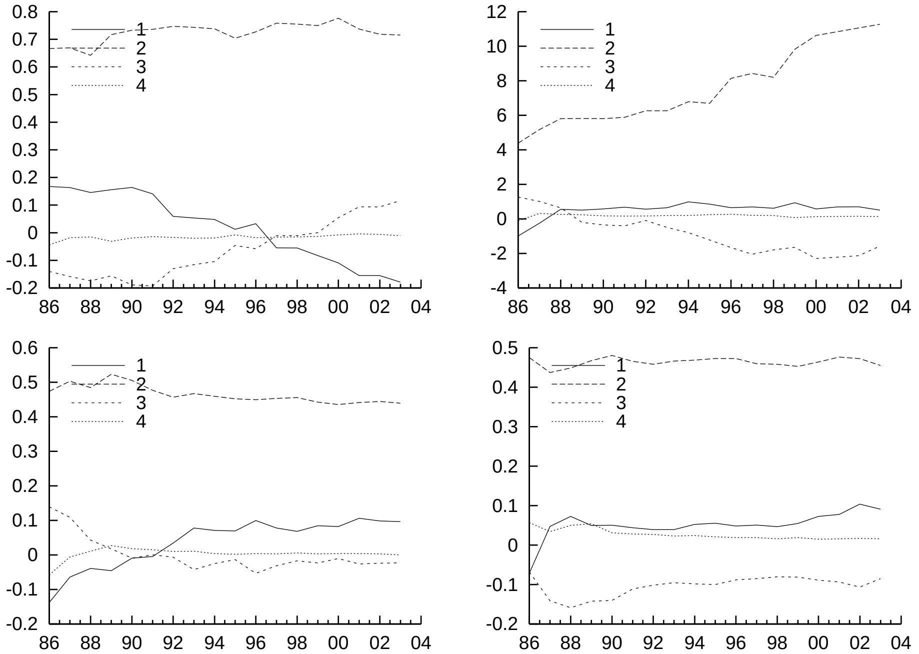


Figure 12: Plot of coefficients estimated using a rolling window from 1986 up to 2003 for SEM2

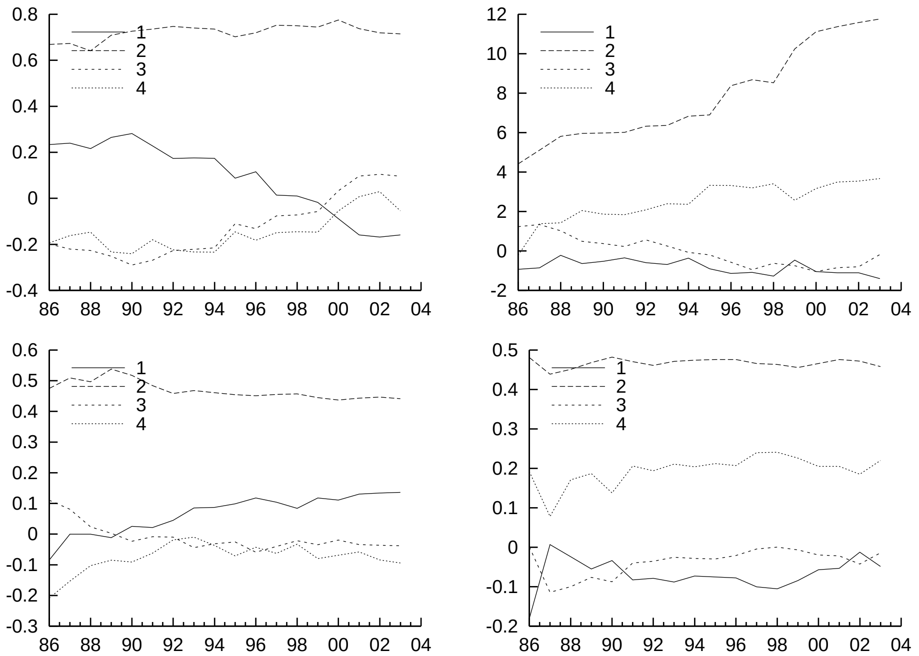


Figure 13: Plot of coefficients estimated using a rolling window from 1986 up to 2003 for SAR3

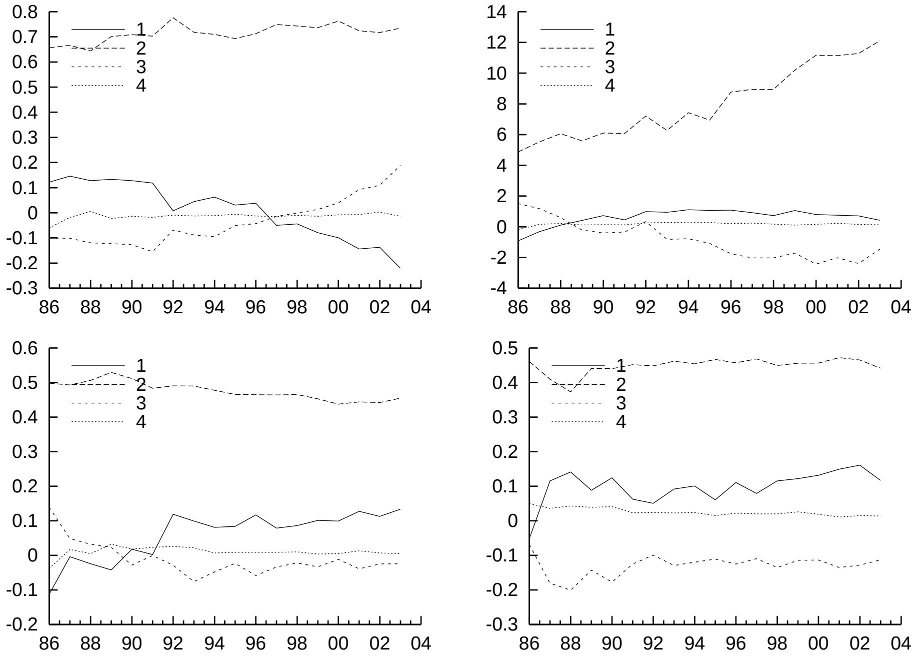


Figure 14: Plot of coefficients estimated using a rolling window from 1986 up to 2003 for SEM3

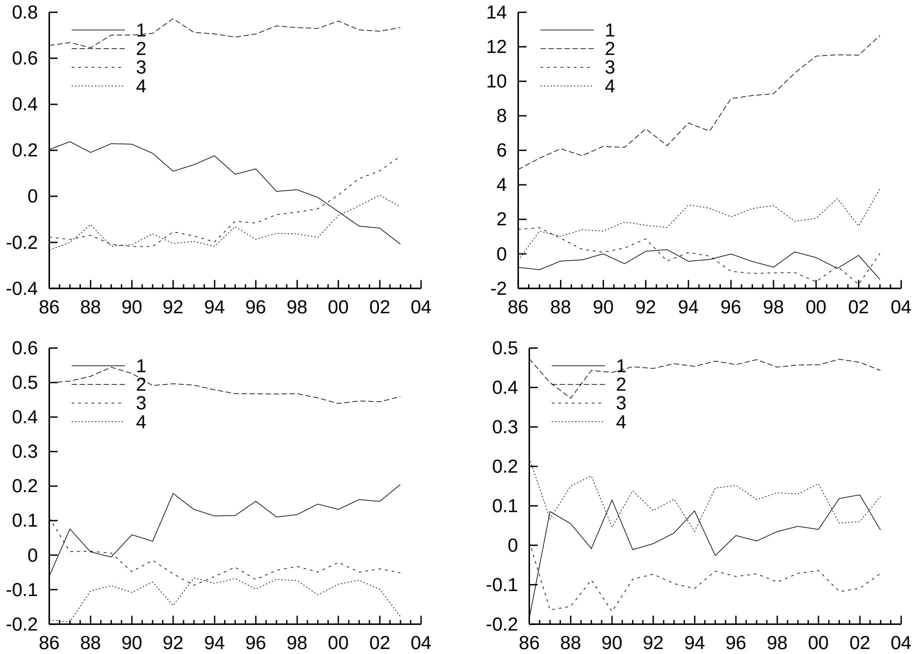


Figure 15: Plot of coefficients estimated using a rolling window from 1986 up to 2003 for SAR4

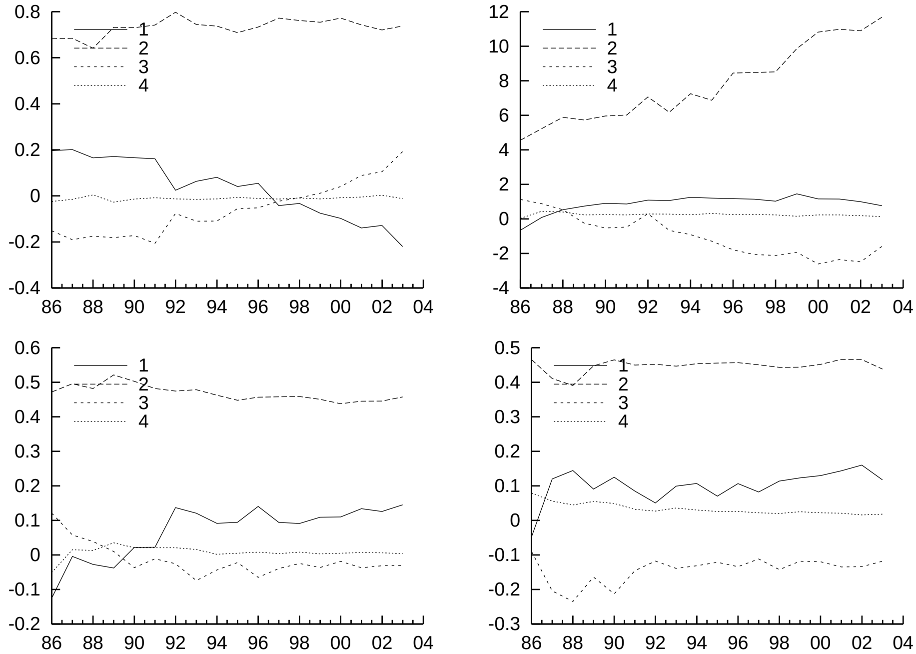


Figure 16: Plot of coefficients estimated using a rolling window from 1986 up to 2003 for SEM4

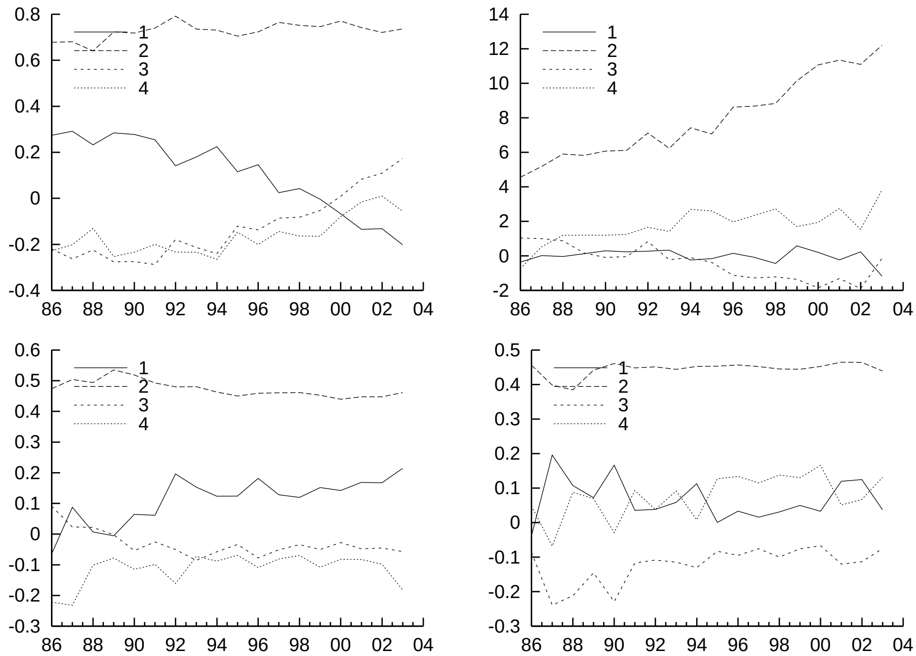


Table 5: Indexes of Spatial Autocorrelation for first log differences of productivity of labour since 1982 up to 2003 about Wholesale and Retail Trade, Repair of Motor Vehicles and Household Goods, Hotels and Restaurants, Transports and Communications

Year	Moran	Moran std.	Burridge	p-value	Geary
(1982)	0.100	0.929	0.263	0.608	0.813
(1983)	-0.386	-2.132	3.902	0.048	1.280
(1984)	0.164	1.332	0.707	0.400	0.745
(1985)	0.081	0.810	0.173	0.677	0.980
(1986)	-0.148	-0.632	0.572	0.449	1.227
(1987)	0.449	3.126	5.288	0.021	0.521
(1988)	0.076	0.777	0.151	0.697	0.987
(1989)	-0.077	-0.183	0.153	0.695	1.036
(1990)	0.136	1.155	0.485	0.486	0.768
(1991)	0.079	0.794	0.162	0.687	1.015
(1992)	-0.066	-0.120	0.116	0.734	0.719
(1993)	0.018	0.411	0.008	0.927	0.766
(1994)	0.254	1.894	1.682	0.195	0.811
(1995)	0.085	0.834	0.190	0.663	0.759
(1996)	-0.081	-0.214	0.174	0.677	1.049
(1997)	-0.213	-1.039	1.182	0.277	1.313
(1998)	-0.157	-0.690	0.646	0.422	1.165
(1999)	-0.320	-1.713	2.674	0.102	1.296
(2000)	-0.050	-0.017	0.066	0.798	1.181
(2001)	0.192	1.507	0.966	0.326	0.872
(2002)	0.011	0.364	0.003	0.957	1.083
(2003)	0.242	1.818	1.527	0.217	0.634

ordinary least squares, and the within transformation taken with respect to time, to space, and to time and space. Moreover other four (respectively SAR1, SAR2, SAR3, SAR4) taking into account a spatial lag together with ordinary least squares, and the within the ordinary least squares, and the within transformation taken with respect to time, to space, and to time and space. Plotting the coefficients obtained recursively enlarging the sample every time with a new set observations of the next year available, I realized which could be the best model in terms of parameters' stability. The results are different for every branch, but SAR and SEM tend to give similar results when the type of transformation used is similar.

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